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Research Article

DISTRIBUTION AND SEVERITY OF ANTHRACNOSE IN SAFED MUSLI (*Chlorophytum borivilianum* Santapau & Fernandez) IN SOUTHERN RAJASTHAN

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Abstract- Anthracnose of safed musli caused by *Colletotrichum chlorophyti* is an economically important disease worldwide. Studies were conducted to determine the causal agent, its distribution and severity in Southern Rajasthan, during two consecutive seasons of *kharif* 2013 and 2014, observations recorded at 60, 75 and 90 days after sowing. Forty fields were surveyed in four districts *viz.,* Udaipur, Rajsamand, Pratapgarh and Banswara. Disease foliage samples were collected to surveyed areas for analyzed the pathogenic studies and identified the causal agent as *C.chlorophyti*.It was revealed that disease appeared varied in most of the surveyed fields in the range from 28.07-73.0 and 27.30-71.10 per cent in both of the years, respectively. In the year of 2013, maximum disease severity mean was recorded in Udaipur and minimum in Pratapgarh districts. In the year of 2014, maximum disease severity was recorded in Banswara and minimum in Pratapgarh districts. The overall disease severity was higher in first year as compared to the second year at all observations. Because off the environmental conditions were highly favorable for disease progress in the year of 2013 as compaired to 2014 during the study period. The disease severity was increased with plants` age which showed that plants would be vulnerable for pathogen with their maturity, so this condition affected the yield. All these above conditions were observed during the study period which found that needed to more effective management strategy at all conditions.

Keywords- *Colletotrichum chlorophyti,* Anthracnose, Distribution, Severity and Safed Musli

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Introduction

Safed musli (*Chlorophytum borivilianum* Santapau and Fernandez) [1] is a promising medicinal herb.The world health organization has estimated that almost 80 per cent of the world population in developing countries depends primarily on herbal medicines for general healthcare needs [2]. Safed musli roots are the main propagative and usable part which contains saponin (12-17%), stigmasterol (1.9-3.5%), sugars [arabinose-b (0.79%), galactose-c (3.80%), glucose-d (0.73%), reducing sugars (20-25%)], non-reducing sugars (15-17%), protein (8-8.50%), 4-hydroxyl-8,11-oxidoheneiosanol, penta-cosyblecosanate, nonacosan, tetra cosaniccic acid, triacontanoic acid, trigogeninnigo gitogemin, tokorogenin, benzyl glucoside [3,4], which is used as herbal alternative to '*Viagra'* raised its popularity even among Western countries [3,5,6] and also commonly used to cure general physical illness and weakness, revitalizer for diabetes, arthritis, curative for natal and postnatal problems, diarrhea, dysentery, gonorrhea, leucorrhea, as stimulant of brain development in children, and for increasing general body immunity, supplementary therapy for blood purification, nervous disorder and some gynecological problems [7-9].

In India, it is mainly cultivated in Southern Rajasthan, Western Madhya Pradesh, Northern Gujarat [10] and Eastern Ghats, Bihar, Andhra Pradesh, Eastern Himalayas [11]. Recently, there has been tremendous increase in the demand of this plant in Indian and International drug markets and a vital entity of more than hundred herbal drug formulations [12-14]. Although Indian forests are rich in safed musli, the ever increasing of demand has led to its commercial cultivation throughout the country. Anthracnose is most important disease of safed musli caused by *Colletotrichum chlorophyti*, which determined our study, where anthracnose on safed musli caused by *C.chlorophyti* [15] and *C. dematium* [16] and *C. capsici* have been reported. The disease was causes considerable damage to the crop every year and sometimes becomes more severe in almost growing areas, which may result in total loss of finger yield and quality. In the *Colletotrichum* patho-system, different species can be associated with anthracnose of the same host [17-19]. *Colletotrichum* spp. is the ethologic agent of anthracnose disease and plays an important role on agricultural subsistence economies world-wide [20-22]. The typical symptoms were described as started in the form of small brownish spots on lamina, more prominent on margin or tip. Similarly, these symptoms were found in the form of sunken lesion that range in colour from dark red to tan black, generally describe as anthracnose disease [23-25]. Safed musli being a vegetatively propagated crop, development of resistant varieties has limitations and commercial resistant varieties are not available. The information on distribution of pathogen species and disease severity is crucial and imperative for more effective disease management strategy. Disease foliage samples were collected to surveyed areas for analyzed the pathogenic studies and identified the causal agent as *C. chlorophyti* which being randomly distributed in most of the surveyed fields and the result of this study are presented and discussed here.

Materials and Methods

Isolation and identification of pathogen: During the surveys diseased materials were collected from different locations and brought to laboratory for isolation on Potato Dextrose Agar (PDA) plates and for further identification of morphological characteristics such as colony, mycelia as well as shape and size of conidia under light microscopy observation and the associated pathogen was identified at generic level by studying their cultural, morphological and pathogenic characteristics with the help of identification keys and compared with using the standard literature [26].

Pathogenicity test: Pathogenicity was tested after inoculation the test pathogen by spray inoculation on pot grown plants of safed musli. The plants were raised in sterilized soil: FYM (3:1) mixture and surface sterilized (0.1% $HgCl_2$ for two minutes) seed fingers were sown in small plastic pot @ 2-3 seed finger/pot. For preparation of the inoculums, the isolated pathogen was cultured within Potato Dextrose Broth (PDB) medium and incubated for 7 days on 28±2^{0}C so as to allow profuse sporulation. Conidia were harvested by filtering them through four layers of cheesecloth to remove mycelia. Conidia concentration was then determined using a haemocytometer and adjusted to 1×10^6 conidia ml^{-1} using Sterile Distilled Water (SDW). Spore suspension was inoculated through spray with a hand atomizer on 45 -day old plants. The inoculated plants were kept in humid chamber for 48 hours and then transferred to cage house and high humidity was maintained throughout the disease development period by frequent irrigations. A suitable control by spraying sterilized distilled water was also maintained. After 15-20 days of inoculation, the typical lesions started appearing on the leaves. In order to confirm the Pathogenicity, Re-isolations were made from these artificially produced diseased symptoms, which yielded the same species of fungus *Colletotrichum*, identical with the type inoculated. Similar results obtained repeatedly and in this way, Koch's postulates proved.

Assessment of disease severity: Surveys were conducted to know the distribution and severity of anthracnose at farmer's fields during two consecutive seasons of *kharif* 2013 and 2014 in safed musli growing areas of Southern Rajasthan. These included districts of Udaipur, Rajsamand, Pratapgarh and Banswara in 40 fields. The surveys aimed to record the severity of the disease, exploring possibility of existence and variations of different species of safed musli anthracnose pathogen. To assess the severity of disease, ten fields were randomly selected and 10 square meter area was marked in a field in each village and observations for disease severity were recorded at 60, 75 and 90 days after sowing by visual scoring [Fig-1]. Meanwhile, the disease severity was determined according to alternative rating scale proposed by Shrestha in which scale 0 = no symptom, scale 1=Traces or 5% leaf area infected, scale 2=6- 10%, scale 3=11-25%, scale 4=26-50% and scale 5=50-100%, respectively. Number of plants in each score recorded and the per cent disease incidence/severity in each plot was determined as:

$$PDI = \frac{n\,x1 + n\,x2 + n\,x3 + n\,x4 + n\,x5}{N} \; X \; \frac{100}{\text{Maximum disease score } (5)}$$

Where,

n = Number of plants in each score, 1-5 = Disease score

N = Total number of plant under observation

Longitude and altitude data from surveyed area were recorded. Cultural data including age of crops and acreage of farms were also noted.

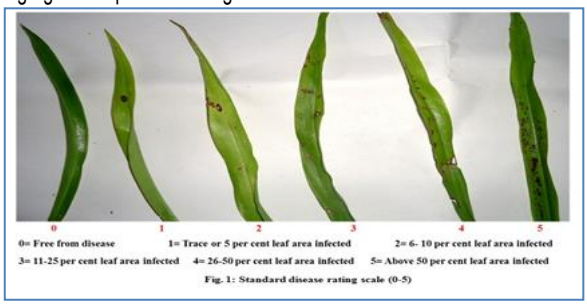

Fig. 1: Standard disease rating scale (0-5)

Statistical data analysis: The data obtained from this study was subjected to analysis for coefficient of variation. The experiments conducted in laboratory and pots using Completely Randomized Design (CRD), was followed. Means of the experimental data were used to compare the distribution and disease severity of each field.

Result and Discussion

Isolation and Identification of the Pathogen: Anthracnose disease on safed musli was characterized with started in the form of small brownish spots on lamina, more prominent on margin or tip. The spots gradually elongate and cover an appreciable area of the leaf [Fig-2]. These lesions had brown centers and then coalesced to rot. Similarly, the typical symptoms of anthracnose was in the form of sunken lesion that range in colour from dark red to tan black, generally describe as anthracnose disease [23-25]. The aservuli were found as the dark concentric circle on the infected leaves. The identification of isolated pathogen described that the fungus had whitish-gray colony, with septatehyphae, aservuli bearing conidia on conidiogenous cells and capsule-like conidia (2.8-24.5×2.0-7.2µm in size) containing one cell. According to Damm*et al.* (2009) [26], this pathogenic fungus was then characterized as *Colletotrichum chlorophyti*.

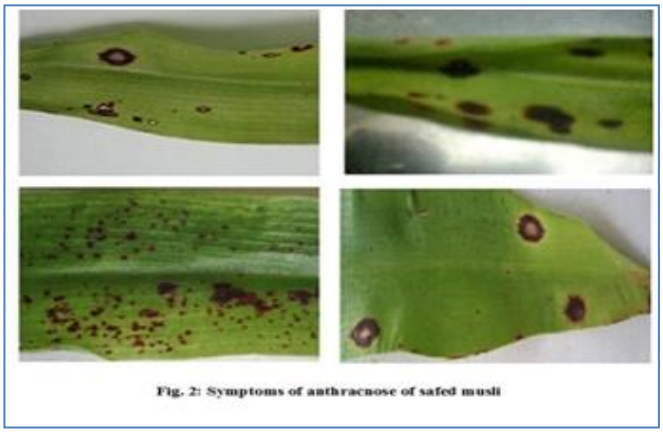
Fig. 2: Symptoms of anthracnose of safed musli

Pathogenicity test: The in vitro pathogenicity test resulted in the appearance of the anthracnose symptoms on inoculated leaves that similar to those found in the field. These typical anthracnose symptoms occurred on the leaves on 15 days after inoculation, respectively. The symptoms on inoculated leaves, in the form of sunken lesion that range in colour from dark red to tan black 45 -days after inoculation. The results of this study confirmed the anthracnose of safed musli caused by *C. chlorophyte* [15]; *C. dematium* [16] and *C. capsici* have been reported. Although these species have been the subject of numerous investigations, there remain many gaps in the knowledge of the disease process and understanding of the complex relationships between the species involved.

Assessment of distribution and severity: Forty fields were assessed along the same route in 2013 and 2014 surveys, respectively. The anthracnose severity was revealed that appeared in most of the surveyed fields which evidences for its distribution and occurrence in large areas [Fig-3]. Perusal of data [Table-1, 2] and [Fig-4, 5] indicated that severity mean of anthracnose varied between 27.69-72.05% in Southern Rajasthan in the year of 2013 and 2014. Survey was conducted in Udaipur district that severity mean was recorded range from 37.23to 71.43% and 28.37 to 70.74% during these study years. Whereas, in Rajsamand that severity mean was recorded range from 31.93 to 70.80% and 29.13 to 69.33% respectively. Among those, in Pratapgarh and Banswara districts the severity was recorded range from 29.33 to 60.27% and 28.07 to 73.0% during the first year where that 27.30 to 68.87% and 32.23 to 71.10% in the second year. The anthracnose severity varied between surveyed districts in respective years. The maximum disease severity mean was recorded in Udaipur (51.69%) and Banswara (50.47%) whereas, minimum in only Pratapgarh (45.84% and 45.86%) during these study years. The overall per cent disease severity was more in 2013

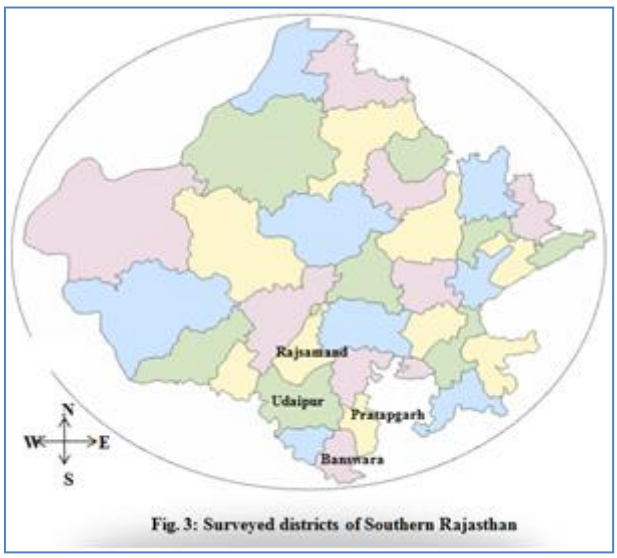

Fig. 3: Surveyed districts of Southern Rajasthan

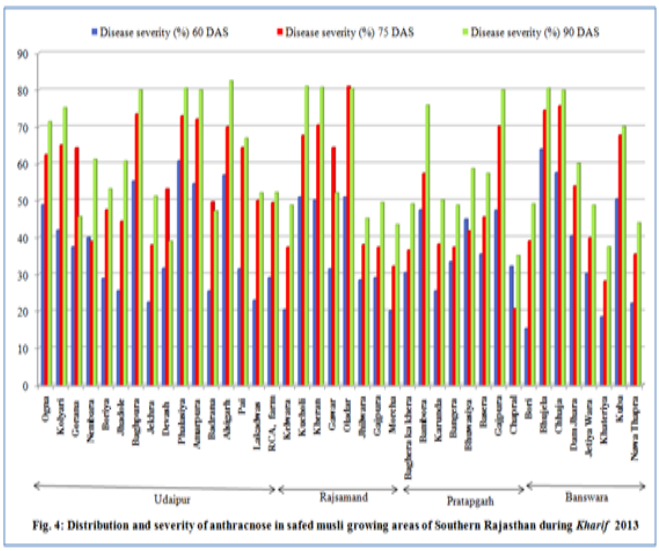

Fig. 4: Distribution and severity of anthracnose in safed musli growing areas of Southern Rajasthan during *Kharif* 2013

Table-1 *Anthracnose disease severity in Safed Musli growing areas of Southern Rajasthan during Kharif 2013*

S. No.	Village	Disease severity (%)			Mean
		60 DAS	75 DAS	90 DAS	
Udaipur					
1.	Ogna	48.90 (44.37)	62.50 (52.27)	71.40 (57.77)	60.93 (51.34)
2.	Kolyari	42.00 (40.39)	65.10 (53.82)	75.20 (60.24)	60.77 (51.24)
3.	Gorana	37.50 (37.75)	64.30 (53.36)	45.70 (42.53)	49.17 (44.52)
4.	Nembara	40.00 (39.23)	39.00 (38.64)	61.20 (51.49)	46.73 (43.12)
5.	Boriya	28.90 (32.51)	47.50 (43.57)	53.20 (46.84)	43.20 (41.09)
6.	Jhadole	25.60 (30.39)	44.40 (41.78)	60.70 (51.19)	43.57 (41.30)
7.	Baghpura	55.30 (48.05)	73.50 (59.15)	80.00 (63.72)	69.60 (56.62)
8.	Jekhra	22.50 (28.31)	38.00 (38.05)	51.20 (45.69)	37.23 (37.59)
9.	Devash	31.70 (34.25)	53.20 (46.84)	39.00 (38.63)	41.30 (39.98)
10.	Phalasiya	60.80 (51.25)	73.00 (58.77)	80.50 (63.97)	71.43 (57.750
11.	Amarpura	54.60 (47.65)	72.10 (58.18)	80.00 (63.59)	68.90 (56.15)
12.	Badrana	25.50 (30.32)	49.70 (44.83)	47.20 (43.49)	40.80 (39.69)
13.	Alsigarh	57.00 (49.03)	70.00 (56.83)	82.50 (65.42)	69.83 (56.72)
14.	Pai	31.50 (34.13)	64.40 (53.40)	66.90 (54.91)	54.27 (47.45)
15.	Lakadwas	23.00 (28.65)	50.00 (45.00)	52.10 (46.21)	41.70 (40.22)
16.	RCA, farm	29.10 (32.64)	49.50 (44.71)	52.20 (46.26)	43.60 (40.32)
Rajsamand					
17.	Kelwara	20.50 (26.91)	37.40 (37.69)	48.80 (44.31)	35.57 (36.60)
18.	Kucholi	51.00 (45.51)	67.70 (55.40)	81.00 (64.31)	66.57 (54.70)
19.	Kheran	50.20 (45.12)	70.50 (57.19)	80.70 (64.25)	67.13 (55.08)
20.	Gawar	31.50 (34.13)	64.40 (53.40)	52.10 (46.210	49.33 (44.62)
21.	Oladar	51.00 (45.58)	81.00 (64.49)	80.40 (64.03)	70.80 (57.39)
22.	Jhilwara	28.50 (32.26)	38.10 (38.41)	45.20 (42.24)	37.27 (37.62)
23.	Gajpura	29.10 (32.64)	37.40 (37.69)	49.50 (44.71)	38.67 (38.44)
24.	Morcha	20.10 (26.63)	32.20 (34.57)	43.50 (21.26)	31.93 (34.40)
Pratapgarh					
25.	Baghera ka Khera	30.50 (33.52)	36.60 (37.22)	49.10 (44.48)	38.73 (38.48)
26.	Bambora	47.50 (43.57)	57.40 949.27)	75.90 (60.70)	60.27 (50.94)
27.	Karunda	25.50 (30.32)	38.20 (38.17)	50.20 (45.12)	37.97 (38.03)
28.	Bangera	33.50 (35.36)	37.40 (37.70)	48.80 (44.31)	39.90 (39.17)
29.	Bhuwasiya	45.00 (42.12)	41.80 (40.27)	58.70 (50.03)	48.50 (44.14)
30.	Basera	35.50 (36.56)	45.60 (42.47)	57.40 (49.27)	46.17 (42.80)
31.	Gajpura	47.40 (43.51)	70.20 (57.01)	80.00 (63.72)	65.87 (54.31)
32.	Chapral	32.20 (34.56)	20.70 (27.05)	35.10 (36.72)	29.33 (32.78)
Banswara					
33.	Bori	15.30 (23.02)	39.10 (38.70)	49.10 (44.48)	34.50 (35.96)
34.	Bhujela	64.00 (53.16)	74.50 (59.75)	80.50 (63.96)	73.00 (58.76)
35.	Chhaja	57.60 (49.38)	75.70 (60.55)	79.90 (63.50)	71.07 (57.510
36.	Dam Jhara	40.50 (39.51)	54.00 (47.38)	60.10 (51.09)	51.53 (45.88)
37.	JetiyaWara	30.30 (33.39)	39.90 (39.17)	48.80 (44.31)	39.67 (39.03)
38.	Khateriya	18.50 (25.46)	28.20 (32.06)	37.50 (37.75)	28.07 (31.98)
39.	Kuba	50.50 (45.49)	67.80 (55.47)	70.10 (56.90)	62.80 (52.44)
40.	NawaThapra	22.20 (28.10)	35.50 (36.56)	44.00 (41.55)	33.90 (35.60)
CD (*P* = .05)		1.44	3.41	3.11	2.16

*Per cent disease severity based on 15 Safed Musli fields randomly selected from each village of different places

as compared to 2014 which showed that highly favorable weather conditions for disease progress were found in the first year as compare to second year [Table-3]. The severity may also increase with plant`s age these were indicated that plants would be vulnerable for pathogen and disease progress fast with their maturity. Hence these indicate that crop residues favorable climate and another reason could lie with the infected seed/finger as importantly and there may be.

Looking to the importance of the disease and intensification of safed musli cultivation in Rajasthan, a need was felt to develop its more effective management strategy. For effective disease management, information on prevalence and distribution of species of *Colletotrichum* is crucial and imperative. However, there are no reports which reveal about its exact time of occurrence and other epidemiological factors.

Table-2 *Anthracnose disease severity in Safed Musli growing areas of Southern Rajasthan during Kharif 2014*

S. No.	Village	Disease severity (%)			Mean
		60 DAS	75 DAS	90 DAS	
Udaipur					
41.	Ogna	45.60 (42.47)	64.50 (53.48)	70.20 (57.00)	60.10 (50.85)
42.	Kolyari	40.00 (39.22)	62.50 (52.26)	74.20 (59.57)	58.90 (50.14)
43.	Gorana	38.50 (38.34)	60.30 (50.97)	50.70 (45.40)	49.83 (44.91)
44.	Nembara	35.50 (36.56)	40.00 (39.23)	60.50 (51.08)	45.33 (42.32)
45.	Boriya	32.70 (34.87)	53.90 (47.24)	55.20 (47.99)	47.27 (43.43)
46.	Jhadole	25.50 (30.32)	40.30 (39.40)	62.80 (52.44)	42.87 (40.89)
47.	Baghpura	60.30 (50.97)	70.50 (57.19)	81.50 (64.88)	70.77 (57.36)
48.	Jekhra	22.50 (28.31)	38.00 (38.05)	50.00 (45.00)	36.83 (37.36)
49.	Devash	32.70 (34.86)	45.70 (42.53)	30.50 (33.51)	36.30 (37.04)
50.	Phalasiya	55.60 (48.22)	70.50 (57.16)	71.00 (57.47)	65.70 (54.18)
51.	Amarpura	50.50 (45.29)	75.80 (60.63)	76.00 (60.77)	67.43 (55.24)
52.	Badrana	27.50 (31.62)	50.70 (45.40)	49.20 (44.54)	42.47 (40.66)
53.	Alsigarh	55.00 (47.87)	61.00 (51.37)	63.50 (52.85)	59.83 (50.68)
54.	Pai	21.50 (27.62)	41.20 (39.93)	61.00 (51.37)	41.23 (39.95)
55.	Lakadwas	21.50 (27.62)	22.50 (28.31)	41.10 (39.87)	28.37 (32.17)
56.	RCA, farm	29.00 (32.57)	49.50 (44.71)	58.80 (50.08)	45.77 (42.57)
Rajsamand					
57.	Kelwara	22.50 (28.31)	36.70 (37.28)	50.80 (45.40)	36.67 (37.26)
58.	Kucholi	50.80 (45.46)	65.00 (53.75)	75.20 (60.21)	63.67 (52.95)
59.	Kheran	55.20 (48.00)	70.50 57.19)	80.50 (64.10)	68.73 (56.08)
60.	Gawar	31.50 (34.13)	64.40 (53.40)	50.20 (45.12)	48.70 (44.25)
61.	Oladar	62.60 (52.34)	70.00 (56.88)	75.40 (60.43)	69.33 (56.26)
62.	Jhilwara	25.50 (30.32)	30.40 (33.35)	31.50 (34.13)	29.13 (32.66)
63.	Gajpura	30.50 (33.51)	60.50 (51.08)	43.30 (41.14)	44.77 (41.99)
64.	Morcha	22.00 (27.96)	38.60 (38.40)	40.50 (39.52)	33.70 (35.48)
Pratapgarh					
65.	Baghera ka Khera	28.50 (32.26)	39.60 (38.99)	45.70 (42.53)	37.93 (38.01)
66.	Bambora	45.50 (42.42)	60.40 (51.02)	74.90 (60.02)	60.27 (50.94)
67.	Karunda	22.50 (28.31)	31.20 (33.95)	51.20 (45.69)	34.97 (36.24)
68.	Bangera	36.50 (37.17)	47.00 (43.28)	49.80 (44.89)	44.43 (41.80)
69.	Bhuwasiya	42.00 (40.39)	34.80 (36.14)	61.00 (51.38)	45.93 (42.66)
70.	Basera	36.50 (37.16)	44.60 (41.90)	60.50 (51.08)	47.20 (43.39)
71.	Gajpura	52.40 (46.38)	70.20 (57.01)	84.00 (66.94)	68.87 (56.16)
72.	Chapral	22.20 (28.10)	21.70 (27.76)	38.00 (38.05)	27.30 (31.49)
Banswara					
73.	Bori	20.20 (26.70)	39.00 (38.64)	50.50 (45.29)	36.57 (37.20)
74.	Bhujela	59.00 (50.20)	70.50 (57.16)	78.50 (62.51)	69.33 (56.42)
75.	Chhaja	57.40 (49.26)	75.70 (60.55)	80.20 (63.72)	71.10 (57.53)
76.	Dam Jhara	43.50 (41.26)	55.00 (47.88)	65.70 (54.20)	54.73 (47.73)
77.	JetiyaWara	32.30 (34.62)	40.90 (39.75)	48.80 (44.31)	40.67 (39.61)
78.	Khateriya	21.50 (27.61)	30.20 (33.32)	45.80 (42.59)	32.50 (34.74)
79.	Kuba	58.50 (49.91)	65.50 (54.06)	75.80 (60.63)	66.60 (54.73)
80.	NawaThapra	22.20 (28.10)	34.50 (35.96)	40.00 (39.23)	32.23 (34.58)
CD (*P* = .05)		1.44	3.41	3.11	2.16

**Per cent disease severity based on 15 Safed Musli fields randomly selected from each village of different places*

Table-3 *Anthracnose severity in Safed Musli growing areas of four districts of Southern Rajasthan during Kharif 2013 and 2014*

S. No.	District Name	Disease severity (%)						Mean	
		60 DAS		75 DAS		90 DAS			
		2013	2014	2013	2014	2013	2014	2013	2014
1.	Udaipur	38.37 (38.06)	37.12 (37.30)	57.26 (49.32)	52.93 (46.74)	62.44 (52.62)	59.76 (50.86)	52.69 (46.63)	49.94 (44.98)
2.	Rajsamand	35.24 (36.10)	37.58 (37.50)	53.59 (47.32)	54.51 (47.68)	60.15 (51.42)	55.93 (48.76)	49.66 (44.86)	49.34 (44.64)
3.	Pratapgarh	37.14 (37.44)	35.76 (36.52)	43.49 (41.14)	43.69 (41.25)	56.90 (49.24)	58.14 (50.07)	45.84 (42.58)	45.86 (45.59)
4.	Banswara	37.36 (37.16)	39.33 (38.46)	51.84 (46.20)	51.41 (45.91)	58.75 (50.44)	60.66 (51.56)	49.32 (44.64)	50.47 (45.32)
Mean		37.03	37.45	54.23	50.64	59.56	58.62	49.38	48.90

Being a short duration crop it was thought to study the occurrence, distribution and prevalence of anthracnose in safed musli growing areas of Southern Rajasthan. This study provides the first quantitative report on the distribution and severity of safed musli anthracnose in Southern Rajasthan. Chandra, reported that *C. chlorophyti* (=chlorophytumi) in India, Allahabad, Alfred Park, on leaves of *Chlorophytum* species in Oct. 1963, [IMI 103806 – holotype; K(M) – isotype, culture ex-type IMI 103806]; Shipton (1978) in Australia, Queensland, Townsville, reported *C. Chlorophyti* to cause anthracnose of *Stylosanthes hamata*, isolated (living culture CBS 142.79).Little information is available on distribution and severity on anthracnose caused by *C. chlorophyti*; therefore, a brief review on

various crops is presented. The results of this study confirmed the observations of a survey was conducted at farmer`s fields and storage conditions in Southern Rajasthan during 2008-10 and 2010-12 also indicated that anthracnose was quite wide spread in the farmer`s fields [27,28]. Similarly, Ngugi*et al.* (2002) [29] assessed the prevalence and severity of sorghum diseases in western Kenya, at farmers' fields and were observed that prevalence of anthracnose caused by *Colletotrichum sublineolum* ranging from 44-65%, respectively Masyahit *et al.* (2009) [30] surveyed 43 fields were recorded 83.72% anthracnose disease severity on three dragon fruit (*Hylocereus* spp.) caused by *Colletotrichum gloeosporioides*. The infected stem and fruit had reddish-brown lesions with chlorotic haloes symptoms. During the study period we were observed that conditions of the farmer`s fields varied from well maintained to very poorly maintained to near-abandoned, with a uniform distribution of these conditions across the fields surveyed in both years. The agronomic condition of the crops also equally varied but in most cases was poor. It was difficult to determine, whether this reflected poor crop management or limitations in edaphic factors. Whereas, most of the farmers were sown of the safed musli in fields where that previous crop was sorghum, which indicated that sorghum residue encourage to anthracnose of safed musli. Ayantu *et al.*, (2014) [31] reported that anthracnose severity caused by *Colletotrichum gloeosporioides* and were recorded that 100% prevalent in the study area at Southwest Ethiopia. The disease incidence under farmer's fields ranged from 41-72.1% on leaf and from 36.274% on fruit.

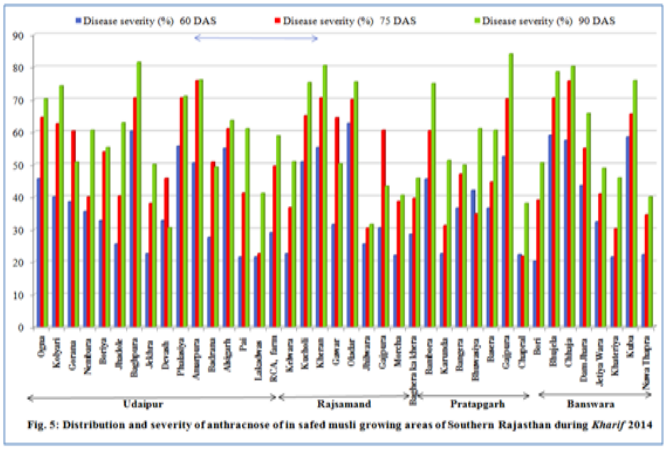

Fig. 5: Distribution and severity of anthracnose of in safed musli growing areas of Southern Rajasthan during *Kharif* 2014

Conclusion

The anthracnose of safed musli is most important disease which is a huge damage to the quality and quantity of finger/root and cause losses to farmer`s economy in Southern Rajasthan. Safed musli being a vegetatively propagated crop, development of resistant varieties has limitations and commercial resistant varieties are not available. During the study period a uniform distribution and varied severity were recorded in surveyed areas. Whereas, most of the farmers were sown of the safed musli in fields where that previous crop was sorghum, which indicated that sorghum residue encourage to anthracnose of safed musli and most of the farmers were sown untreated seeds. Looking to the importance of the disease and intensification of safed musli cultivation in Rajasthan, a need was felt to develop its effective management strategy but the information on distribution and severity of species of *Colletotrichum* is crucial and imperative.

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Abbreviations:

C	–	celsius	ml	–	millimeter
cm	–	centimeter	mm	–	millimeter
fig.	–	figure	No.	–	number
g	–	gram	PDA	–	Potato dextrose agar
ha -	–	hectare	SEM	–	Standard error of mean
hrs	–	hours	µm	–	Micrometre
kg	–	kilogram		–	

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